

## ROLL-PITCH-ROLL SURGICAL TOOL

### ABSTRACT OF THE DISCLOSURE

A robotic surgical tool includes an elongate shaft having a working end and a shaft axis, and a pair of linking arms each having a proximal end and a distal end. The proximal end is pivotally mounted on the working end of the shaft to rotate around a first pitch axis to produce rotation in first pitch. A wrist member has a proximal portion pivotally connected to the distal end of the linking arm to rotate around a second pitch axis to produce rotation in second pitch. An end effector is pivotally mounted on a distal portion of the wrist member to rotate around a wrist axis of the wrist member to produce rotation in distal roll. The wrist axis extends between the proximal portion and the distal portion of the wrist member. The elongate shaft is rotatable around the shaft axis to produce rotation in proximal roll. At about 90° pitch, the wrist axis is generally perpendicular to the shaft axis. The proximal roll around the shaft axis and the distal roll around the wrist axis do not overlap. The use of the linking arms allows the end effector to be bent back beyond 90° pitch. The ability to operate the end effector at about 90° pitch and to bend back the end effector renders the wrist mechanism more versatile and adaptable to accessing hard to reach locations, particularly with small entry points such as those involving spinal, neural, or rectal surgical sites.